19 FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT OFFICE

12 **Publication**

10 **DE 32 24 597 A1**

51 Int. Cl. [3]

**H 01B 7/00**

21 File reference: P 32 24 597.1
22 Filing date: 29. 6.82
43 Date of publication: 29.12.83

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# 54 Flexible power line with stranded conductors

A power line contains, in the core or in the fillers of the stranded electrical conductors distributed symmetrically on the cross-section of the line, one or more optical conductors which are provided with an external braiding or a braid (10) made from elements resistant to tensile stresses which assumes the overall load strength of the line. The elements resistant to tensile stresses may be steel or plastic flexible wires or mixed steel-copper flexible wires.

(32 24 597)

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Claims

1. A flexible power line for supplying power and/or for controlling portable consumers,
consisting of three or more electrical and one or more optical conductors stranded together and a jacket surrounding the conductors,
c h a r a c t e r i s e d i n t h a t
the optical conductors (14) distributed symmetrically across the cross section of the wire are provided with a braiding or braid (10) made from elements of a high tensile strength, which impart guaranteed mechanical strength to the line as a whole.

2. A power line as claimed in claim 1,
c h a r a c t e r i s e d i n t h a t the elements resistant to tensile stress consist of steel wires or flexible steel wires or flexible wires made from high-strength plastic threads.

3. A power line as claimed in claim 1,
c h a r a c t e r i s e d i n t h a t the elements resistant to tensile stress consist of mixed steel-copper flexible wires.

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Our reference
VPA **82P4082**

Flexible power line with stranded conductors

The invention relates to the field of power supply and/or the control of portable consumers and may be used in the structural design of power lines which are also suitable for signal transmission.

Flexible power lines containing three current-carrying conductors and an earth wire or protective conductor are used as a means of supplying power to portable consumers such as excavating equipment used for construction or cranes or loading bridges in ports. In the case of round power lines with stranded conductors, the earth and/or protective wire may be arranged in the filler cavities of the conductors or on the conductors themselves or alternatively may form a fourth conductor (DE-AS 26 19 223). As a means of controlling lifts, round cables with stranded conductors are known, in which the conductors are arranged in single or multiple layers around a bearer wire and jointly encased therewith (DE-AS 14 65 317, DE-AS 14 65 777).

Another power line consisting of stranded conductors is known as a means of supplying power to diggers and is also capable of transmitting control signals. To this end, a cabling element (optical conductor) is housed in at least one external filler, containing one or more optical waveguides. These are placed loosely in sheath-like multi-layered plastic envelopes which are stranded onto a core element that is highly resistant to tensile stresses and jointly surrounded by a first envelope made from pre-stretched aromatic polyamide and a second, loosely fitted second envelope made from a fluorinated ethylene-propylene copolymer. This

structure ensures that the optical waveguide is stretched and bent in a permissible manner only. Accordingly, changes in the length of the power line are partially compensated by changes in radius. The load capacity of the line as a whole can be determined by flexible steel wires arranged in the core of the current-carrying conductors (DE-OS 28 01 231). In another known line of this type, the optical conductors consist of several individual optical waveguides arranged in sheaths, which are stranded onto a core in the form of an isolated electrical conductor, a plastic line or a bearing member and jointly surrounded by a jacket (GB-OS 2 035 599).

Based on a flexible power line having the features outlined in the generic part of claim 1, the underlying objective of the invention is to provide an arrangement of electric conductors, optical conductors and bearing members which are compatible with one another in terms of manufacture, dimensions and operating behaviour.

In order to achieve this objective, the invention proposes that the optical conductors distributed symmetrically on the cross-section of the line should be provided with a braiding or braid made from elements with a high resistance to tensile stresses which impart a guaranteed mechanical strength of the line as a whole.

In addition to carrying high quantities of energy, a power line of this type will also be capable of transmitting large quantities of data, which means that the new line will primarily be suitable for use with portable consumers which are linked up to control and computer systems with a high inherent data flow and fitted with a television transmission system if necessary. This will be the case, for example, with

modern loading-bridges for containers which are controlled via central computer systems, and for lift control systems in high-rise buildings.

With this new power line, the optical conductors are integrated in the bearing member which provides the tensile strength of the line as a whole or several such bearing members. On the one hand, this ensures that the optical waveguides are securely protected from unacceptable tensile stresses and on the other offers advantages from an application and manufacturing point of view due to the fact that the bearing member is integrated in the line as a whole. Combining the bearing member and optical conductors means that the optical conductors at the centre of the line or several optical conductors distributed symmetrically on an arc can be arranged in the fillers of the current-carrying conductors or inside a braiding without having to enlarge the diameter of the line. Compared with known structures with electrical conductors reinforced to withstand high tensile stresses, it is even possible to make the diameter smaller.

Depending on how the line is constructed and the transmission voltage, the elements proposed by the invention with a high tensile strength may be made from flexible steel wires or a steel conductor or from high-strength plastic threads or from a mixed steel-copper flexible wires. In the case of power lines, the protective wire may form one or more independent conductors or be integrated in several optical wires; if the protective wire is integrated in the optical wires, the high-strength elements used may be made from mixed steel-copper flexible wires. The use of flexible steel wires or plastic threads for the bearing member is of specific interest in the case of control lines for lifts.

Embodiments of the new power line are illustrated in the drawings. Figures 1 to 3 illustrate three different embodiments of optical conductors used for the new line whilst figures 4 to 7 show embodiments of the new line as a whole.

Fig. 1 illustrates an optical conductor in which two optical waveguides 1 are stranded with a braid 4 arranged in a covering 6 made from plastic. Mounted on this sheath-like covering is a braiding 8 made from plastic threads which are highly resistant to tensile stresses. Furthermore, the jacket 9 is made from polyethylene, polyamide, a fluoroethylene polymer or polyurethane, for example. Arranged on this jacket 9 is a braid 10 made from long-twisted elements of high tensile strength which may be steel wires or flexible steel wires or flexible wires made from high-strength plastic threads or mixed steel-copper flexible wires.

The braiding 8 protects the optical wave guides 1 whilst the outer braid 10 forms a bearing member which will impart tensile strength to the line as a whole. This braid simultaneously protects the optical waveguides 1. Instead of a braid, it would also be possible to use a single- or multi-layered braiding.

In the case of the optical conductor illustrated in Fig. 2, several optical waveguides 2 are loosely arranged in a plastic envelope 6, which is also filled with a filler, not illustrated. Arranged on the plastic envelope 6 is the braiding or braid 8 and on top of it the jacket 9, on which a braid 10 is in turn placed.

In the case of the optical conductor illustrated in Fig. 3, several optical waveguides 3 with individual sheath-like envelopes are loosely laid up around a core element 5 made from a plastic thread with high tensile strength and encased in a braiding 7 on which a braid 8 is placed. The jacket 9 surrounding the braid 8 is in turn provided with braiding 10.

Fig. 4 illustrates a power line 11, in which the three current-carrying conductors 12 and their protective conductors 13 split three-ways are laid up around the shaped core 14. The laid-up elements are surrounded by the inner jacket 15 and the outer jacket 16. Arranged at the centre of the line and hence at the centre of the core 14 is the optical conductor 17, which bears on its exterior the braiding or braid 10 of flexible steel wires. This braid provides the overall tensile strength of the line under mechanical stress.

Fig. 5 illustrates a power line which also has three current-carrying conductors 12 and protective wires split three-ways in the filler cavities, the conductors 12 and three-part protective lines being laid up on the shaped core 20. The optical conductors 19 contain the optical waveguide or waveguides in the core whilst mixed steel-copper flexible wires are provided as braiding elements for the braid 10. The flexible copper wires therefore form the protective wires whilst the flexible steel wires act as a bearing element. The optical conductors 19 may also be provided with an external, electrically conductive plastic layer 21 if the line 18 is to be a high-voltage line.

In the embodiment illustrated in Fig. 6, the three current-carrying wires of a power line 22 are split in two so that six conductors 12' are laid up around

the central optical conductors 23. Apart from the protective line integrated in the braid 10, this optical conductor also has an external plastic jacket 24.

Fig. 7 illustrates a control line for a lift 25, the electrical conductors 26 of which are laid up in two layers on the centrally arranged optical conductors 17. This is provided with a braiding 10 of high-strength plastic threads. The line as a whole is surrounded by the plastic jacket 27.

7 drawings

3 claims